



**US Army Corps of Engineers
Los Angeles District**

**Rio Salado Oeste
Salt River-Phoenix, Arizona**

FEASIBILITY REPORT SUMMARY

U.S. Army Corps of Engineers
South Pacific Division, Los Angeles District
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**Rio Salado Oeste
Salt River-Phoenix, Arizona**

1.0 STUDY INFORMATION

A. Study Authority. This report presents the findings of a feasibility study for the Rio Salado Oeste study area along the Salt River in Phoenix, Arizona. The Salt River is a significant tributary to the Gila River in the State of Arizona. This report was prepared as an interim response to two authorities provided by Congress. The first authority is Section 6 of Public Law 761, dated June 28, 1938, known as the Flood Control Act of 1938, which reads in part as follows:

...the Secretary of War is hereby authorized and directed to cause preliminary examinations and surveys...at the following localities: ...Gila River and tributaries, Arizona.

The most recent authority is provided by a Resolution of the Committee on Public Works and Transportation, U.S. House of Representatives, adopted May 17, 1994 (Docket 2425) which states:

...the Secretary of the Army is requested to review the reports of the Chief of Engineers on the State of Arizona...in the interest of flood damage reduction, environmental protection and restoration, and related purposes.

B. Study Sponsor. The non-Federal sponsor for the feasibility study and plan implementation is the City of Phoenix, with the cooperation of the Flood Control District of Maricopa County.

C. Study Purpose and Scope. This feasibility study provides an interim response to the study authority. The purpose of this study is to define environmental degradation and water resource related problems and to investigate the feasibility of providing solutions to these problems. The scope of this study consists of: a) the identification of problems and opportunities associated with loss of riparian habitat and related water resource concerns; b) the formulation of alternative measures for environmental restoration, reduction of future flood damages and maximization of National Environmental Restoration (NER) and National Economic Development (NED) benefits; and c) the identification of the opportunity and the role for Corps participation in environmental restoration and related water resources planning.

D. Project Location/Congressional District. Project Location. The study area is located in Maricopa County, Arizona, and is entirely within the City of Phoenix (**see Figure 1-0**). The study area includes the Salt River from 19th to 83rd Avenues, eight miles, on the Southwest side of Phoenix, Arizona.

Congressional District(s). The study area is entirely within the 4th District of Arizona. Congressional interests are Senator John McCain, Senator Jon Kyl, and Rep. Ed Pastor.

E. Prior Reports and Existing Water Projects. Various agencies and engineering consulting firms have conducted or published over 50 studies and reports on the Salt River since 1980. The topics of the reports or studies include water resources, flood control, recreation and urban development, and environmental assessment. A sample of the prior studies and reports is presented by topic below, and in effect provide a history of water resources studies in the area.

Water Resources Studies or Reports

- 1974, Maricopa Association of Governments (MAG) completed an overall conceptual plan for a Salt River redevelopment.
- 1981, the Corps of Engineers investigated water and related land resources issues in the Phoenix Metropolitan area.
- 1982, Water Resources Associates, a private engineering consulting firm, conducted a study that evaluated the potential water sources and flood control options for a regional redevelopment of the Salt River.
- 1992, the Corps of Engineers completed the *Central Maricopa County Reconnaissance Study*.
- 1993, the U.S. Bureau of Reclamation (USBR) completed the Conceptual Design for the Tres Rios Demonstration Wetlands.
- 1994, Arizona State University completed a geomorphic assessment of the Salt River.
- 1994, City of Phoenix completed a report summarizing problems of the river as it passes through the city.
- 1998, the Corps completed the feasibility report and Environmental Impact Statement (EIS) for the Rio Salado Project.
- 2000, the Corps completed a feasibility report and EIS for the Tres Rios, Arizona Project. The project is currently in the design phase.

Flood Control Studies or Reports

- 1981, the Corps prepared a document evaluating flooding along the Salt and Gila.
- 1989, Simons, Li & Associates, Inc., a private engineering consulting firm, prepared a report on the channelization of the Salt River through Tempe, Arizona.
- 1989, Corps of Engineers completed the Salt-Gila Reconnaissance Report.
- 1994, the Corps completed a bank-stabilization study on the Salt River.
- 1994, the FCDMC completed a land use and structures assessment on the Salt River.
- 1996, the Corps, in cooperation with the USBR, completed an analysis of various release plans for the operation of the modified Roosevelt Dam.

Environmental Assessment Studies or Reports

- 1987, Dames & Moore, a private engineering consulting firm, completed an investigation of the waste sites within the Salt River bed.
- 1994, the Corps of Engineers completed an environmental evaluation on the Salt River.
- 1997, CH2MHILL prepared the “Salt-Gila River Baseline Ecological Characterization”

F. Federal Interest. The primary Federal interest is contribution to National Ecosystem Restoration (NER) through restoration of degraded ecosystem structure, function, and dynamic processes to a less degraded, more natural condition. National Economic Development (NED) benefits which were also evaluated in this study include flood damage reduction and recreation. Based on the results of environmental, hydrologic/hydraulic, and economic analyses, flood damage reduction as a project purpose could not be justified as a separable feature, although the Recommended Plan does provide incidental flood damage reduction benefits. Recreation benefits were found to be justified and the recreation plan is included in the recommendation. To insure recommendation of an efficient plan, alternatives were developed spanning a wide range of both output and cost. Project outputs were evaluated using functional assessment techniques, and detailed cost estimates were developed for all alternatives. Cost effectiveness and incremental cost analysis was conducted to identify cost efficient and best buy plans, leading to the identification of the Recommended Plan.

2.0 STUDY OBJECTIVES

A. Problems and Opportunities. Problems. Key problems within the study area, although include severe ecosystem degradation as a result of land use changes, groundwater overdraft and modifications to the river channel and hydrology. There is potential for flood damages throughout the study area and recreation opportunities associated within riverine and riparian habitat in the Phoenix area are lacking.

Opportunities. There are opportunities to restore riparian habitat and river function, reduce flood damages and increase recreation opportunities.

B. Planning Objectives. Specific planning objectives were identified for this feasibility effort through coordination with local and regional agencies, the public involvement process, site assessments, interpretation of prior studies and reports, and review of existing water projects. Those objectives consider both NER and NED as Federal objectives. The specific study objectives have been identified as follows:

- Restore native riparian, wetland, and floodplain habitats and manage undesirable plant, fish, and wildlife species.
- Reduce flood damages to infrastructure and structures.
- Improve passive recreation and environmental-education opportunities.

C. Planning Constraints. Planning constraints were identified as potential contaminants or hazardous waste from landfills, possible bird strike hazard at adjacent airports, avoiding the increase of disease vectors (such as mosquitoes), maintenance of floodway capacity, proximity to existing and planned bridges, compatibility with continued operation of sand and gravel mining and other land uses.

3.0 ALTERNATIVES

A. Plan Formulation Rationale. Alternatives plans have been formulated in consideration of current Federal, State, and local planning and environmental guidance,

laws, and policy concerning ecosystem restoration, flood damage reduction, recreation, water quality, and related purposes.

Ecosystem restoration: Specific rationale for formulating restoration alternatives considered the importance of the river system and connectivity between up and downstream projects. Measures were combined to form alternatives and consideration was given to location within the floodplain, ecological conditions, water availability, habitat significance, and sustainability in formulating those alternatives.

Flood damage reduction: Both structural and non-structural measures were considered to reduce flood damages throughout the study area. These included levees, floodwalls, relocation, and channelization. Although none of the measures were economically justified, it was discovered that a local plan to modify a portion of the floodplain will largely reduce damages in the future without a project.

Recreation: The recreation plan was developed by the non-Federal sponsor in cooperation with the Corps study team. It was developed to be consistent with Corps policy on development of recreation at ecosystem restoration projects as outlined in Policy Guidance Letter No. 59, USACE 1998.

B. Management Measures and Alternative Plans. Measures. Restoration measures were developed based upon those identified in the Reconnaissance Phase of the study. Additional potential measures were then added based upon the results of public involvement efforts, the physical characteristics of the reach of the river being studied, and upon other similar studies or projects in the region. Those included:

- Create water supply and distribution
- Establish mesquite bosques
- Create cottonwood/willow galleries
- Establish wetlands
- Incorporate existing ponds or gravel pit lakes
- Create base flow
- Incorporate vector control
- Control invasive species
- Clean-up Debris
- Improve levee/channel
- Create recreation corridor
- Consider cultural resources mitigation

Alternative Plans. The preliminary measures above were refined and incorporated into the development of alternatives. Those refinements and modifications to alternatives were completed in plan-formulation meetings with numerous study participants, and took into account study findings and public/agency input.

First Array. The first array consisted of 20 alternatives. Screening of these alternatives was accomplished by applying three factors: completeness, effectiveness and flooding.

Completeness was the consideration of whether the alternative included all of the necessary actions to carry out the objective of restoration. Effectiveness was a measure of the extent to which an alternative plan alleviates the specified problems and achieves the restoration of important habitat types. Flooding considered whether the alternatives had the potential to induce flood damages. This preliminary screening of alternatives reduced the 20 alternatives to 12, including no action. It was meant to narrow the focus to those alternatives that are suitable for further detailed consideration.

Second Array. Although the second array of alternatives appeared to be complete and effective at meeting the objective, the study team observed that further refinement was necessary to aid the selection process. The team determined that three critical components that had to be present for continued evaluation of an alternative: the presence of cottonwood-willow cover type, incorporation of storm water outfalls and restoration of the channel. Cottonwood-willow is an important component of a functioning riparian ecosystem, it was present at all of the reference sites referred to in functional modeling, and meeting the objective of restoration requires that it be included. Storm water outfalls not only represented inexpensive water sources, but have ultimately replaced the existence of natural tributaries to the channel and are therefore critical components to a functioning system. Channel restoration provided a connection to other projects, was a potential means of water distribution, is important for the ecosystem, and contributed to reducing flooding potential. By applying these criteria, the number of alternatives was further reduced to five, including the no action alternative.

C. Final Array of Alternatives. The five remaining alternatives were modified during evaluation of benefits to include different scales of restoration associated with existing lakes or ponds within the study area. These included differing levels of restoration based mainly on different water levels and habitat configurations within the gravel pit lakes. Two alternatives (3 and 4) were very similar in benefits and costs and were combined into one (Alternative 4). Four additional alternatives were evaluated during policy review to assure that the Cost Effectiveness and Incremental Cost Analysis provided an evaluation of alternatives covering a full range of both output and cost. Based on the cost effectiveness and incremental cost analysis two alternatives were identified as “Best Buy” plans. The following table shows the output in acres projected for the final array of alternatives.

Alternatives	Table 1. Cover Type Acreages for Final Array of Alternatives Rio Salado Oeste, Salt River-Phoenix, AZ						
	Cottonwood /Willow	Mesquite	Wetlands	Riparian Scrub	Open Water	Scrub Shrub	Channel
Alternative 2	66	43	45	125	0	305	170
Alternative 4	348	409	67	165	0	63	170
Alternative 5	375	417	110	296	40	92	170
Alternative 5A	375	417	190	296	0	52	170
Alternative 5B	375	417	170	296	20	52	170
Partial	30	30	15	75	0	52	48
Refine 1	210	56	140	125	0	323	170
Refine 2	204	110	140	125	0	551	170
Refine 3	169	102	92	125	0	472	170

Alternative 5A: This alternative includes modification and/or restructuring of the primary conveyance channel to a more natural state by grading, terracing the river corridor from 19th to 83rd Avenues. It also modifies existing stormwater outfall areas to improve retention and increase the existing habitat currently supported by these outfalls. At locations identified as suitable throughout the project area, cottonwood/willow and mesquite cover types would be restored. It also includes regrading the existing gravel pits to restore them to the floodplain, and restoring emergent wetland and riparian areas. This alternative would also address the management, control, and removal of invasive species within the study area. Approximately 1,500 acres are required for this alternative that restores the following acres of habitat: cottonwood/willow 375, mesquite 417, emergent wetlands 190, riparian scrub 296, and scrub shrub 56. It includes approximately 170 acres of low flow channel.

Refine 1: This alternative includes restoration of the river channel from 19th to 83rd Avenues, modification of existing storm water outfalls and restoration of associated habitats and restoration of the two existing gravel pit lakes. Management of invasive species is also addressed with this alternative. Approximately 1024 acres are required to implement this alternative. Acres restored with this alternative include: cottonwood-willow 210, mesquite 56, wetlands 140, low flow channel 170, riparian scrub 125 and the remaining areas would be scrub shrub.

D. Comparison of Alternatives. Ecosystem benefits were evaluated with a functional assessment model which was designed to evaluate the future changes in quantity (acres) and quality (functional capacity) of riverine, wetland, and riparian ecosystems. Model outputs are compared in Average Annual Functional Capacity Units (AAFCU's) for each alternative. The NER plan was identified by examining the net AAFCU's for each alternative versus the net average annual costs for the alternative.

The alternatives evaluated result in increased AAFCUs (relative to without-project conditions) ranging from 33 to 267, or increase from 6 to 46%. Alternative Refine 1 costs \$41,050 annually per AAFCU and Alternative 5A costs \$45,300 annually per AAFCU. The incremental average annual cost per incremental AAFCU is about 33 percent higher than Alternative Refine 1. However, Alternative 5A provides 83 AAFCUs more than Alternative Refine 1, representing an increase in output of 46 percent. Alternative 5A would possess the greatest diversity of habitat and would restore significantly more of the rare and critically important cottonwood-willow and mesquite habitats. Alternative 5A would have the greatest potential benefits to the greatest number of wildlife species in the study area, especially to species that are regionally rare or declining. After consideration of the National Objectives and other associated evaluation criteria Alternative 5A was selected as the recommended plan.

E. Key Assumptions. The primary assumptions identified for the Without-Project Condition was that the existing cottonwood/willow cover type was projected to decrease from 112 acres to 25 acres, and existing wetland was projected to decrease from 30 to 25 acres as well. It is assumed that the quality of that remaining habitat would be low with high concentrations of invasive species such as salt cedar. Although there are scattered

mesquite trees within the study area, none are dense enough to consider a mesquite cover type. It was assumed that with channel restoration emergent wetland vegetation and riparian scrub would regenerate with the channel as it has upstream on the Rio Salado project.

F. Recommended Plan. Alternative 5A includes restoration of approximately 1,500 acres of riverine habitat throughout the 8-mile study area. Approximately 847 AAFCUs would be available with the project, an increase of nearly 46 percent over without-project conditions where there were projected to be 580 AAFCUs. Alternative 5A has an estimated restoration cost of \$153,776,850 with an annual cost of \$12,367,000 including \$2,083,000 annual O&M.

Restoration features of the alternative include restoration of the river channel to a more natural state by grading and terracing the channel from 19th to 83rd Avenues; modification of stormwater outfalls to improve water retention; restoration of cottonwood/willow, mesquite, and wetland cover types through the project area; and the restoration of two old gravel pit lakes to wetland and riparian complexes. The alternative also includes control of invasive species such as saltcedar and arundo throughout the life of the project. Water supply and distribution for the alternative is to be provided through a combination of 8 million gallons per day (mgd) of reclaimed effluent from the 23rd Avenue Waste Water Treatment Plant, and harvesting of storm water.

The recreation plan includes 16 miles of multipurpose trails, access points and parking, shelters, utilities and restroom facilities as well as access control and signage. Cost of the recreation plan is \$11,173,000 or an annual cost of \$1,456,000 including \$800,000 annual O&M. Annual benefits are estimated at \$2,889,000 or net benefits of \$1,433,000 and a benefit/cost ratio of 1.98.

G. Systems / Watershed Context. Rio Salado Oeste is one of five separate federal projects in various stages of completion along the Salt River in Maricopa County. The Tres Rios ecosystem restoration and flood damage reduction project, currently under design, is located immediately downstream of Rio Salado Oeste. Rio Salado Phoenix and Rio Salado Tempe, both primary purpose ecosystem restoration projects, are located upstream of Rio Salado. Rio Salado Phoenix has been opened for public use, while Rio Salado Tempe is currently under construction. Immediately upstream of Rio Salado Tempe is the Va Shly' ay Akimel ecosystem restoration project will restore 14 miles of the Salt River from the Pima Freeway (SR 101) upstream to the Granite Reef Dam. Coupled with several local projects (Tempe Town Lake and Rio Salado Pathway), these federal projects will restore 42 miles of the Salt River from the Granite Reef Dam downstream to the Salt-Agua Fria River confluence. These projects will also provide 4,734 acres of restored habitats in the Salt River watershed, and 58.5 miles of recreational paths for public use.

H. Environmental Operating Principles. The recommended plan strongly supports the USACE Environmental Operating Principles as outlined below:

1. Environmental Sustainability. The project was designed for minimum OMRR&R, local attenuation of flood flows, and harvesting of storm water to increase sustainability of the riparian areas.
2. Consider Environmental Consequences. The project was designed to achieve a system that is more natural that will support riparian life.
3. Seek Balance and Synergy. This project will provide a wildlife corridor and ecosystem benefits within the urban areas. Recreation plan developed to keep recreational users out of restored areas.
4. Accept Corporate Responsibility. Project was designed for full compliance with National Environmental Policy and Endangered Species Acts.
5. Mitigate Impacts. Project was designed to minimize impacts during construction. Long term impacts are positive by restoring the environment.
6. Understand the Environment. A multi-stakeholder, scientific and economic approach was used to obtain information for the study and develop the recommended plan.
7. Respect Other Views. The study team solicited, listened to, and incorporated the views of others through public workshops and monthly team meetings.

I. Independent Technical Review. Independent Technical Review (ITR) was performed by the USACE Sacramento District. Substantive comments involved the description of the significance of ecological resources to be restored, description of LERRD requirements and development of appropriate point values for evaluation of recreation benefits. Additional effort was put towards describing the significance of the resources being restored, LERRD requirements were described and point values reevaluated in the recreation plan. All ITR comments were resolved.

4.0 EXPECTED PROJECT PERFORMANCE

A. Project Costs. Project first costs are identified in Table 2.

**Table 2 Recommended Plan First Costs
Rio Salado Oeste, Salt River-Phoenix, AZ
(September 2006 Price Levels)**

Cost Type	Amount
Construction - Restoration	\$94,112,356
Construction - Recreation	\$11,173,445
LERRDs	\$55,900,000
Monitoring/Adaptive Management	\$3,764,494
Total First Costs	\$164,950,295

B. Equivalent Annual Costs and Benefits. Annualized project costs are presented in Table 3.

Table 3 Equivalent Annual Costs and Benefits
Rio Salado Oeste, Salt River-Phoenix, AZ
 (September 2006 Price Levels, 50-Year Period of Analysis, 5.125% Discount Rate, in \$1,000s)

Cost Type	Amount
Investment Costs (Restoration):	
Total First Costs	\$153,777
Interest During Construction	\$15,770
Total Investment Cost	\$169,547
Average Annual Costs	\$9,467
OMRR&R	\$2,083
Water	\$817
Total Average Annual Costs	\$12,367
Functional Capacity Units	267
Average Annual Cost per FCU	\$45.30
Investment Costs (Recreation):	
Total First Costs	\$11,173
Interest During Construction	\$573
Total Investment Cost	\$11,746
Annual Costs	\$655
OMRR&R	\$800
Total Annual Costs	\$1,456
Net Annual Benefits	\$2,889
Benefit/Cost Ratio	1.98 to 1

C. Cost Sharing. In accordance with the cost sharing provisions of the Water Resources Development Act (WRDA) of 1986, as amended, the ecosystem restoration portion of the project would be cost shared 65-percent Federal and 35-percent non-Federal. Recreational features would be cost shared 50 percent Federal and 50 percent non-Federal. Estimated cost apportionments are provided in Table 4.

Table 4 Cost Apportionment
Rio Salado Oeste, Salt River-Phoenix, AZ
(Costs x \$1000)

Item	Apportionment		
	Federal	Non-Federal	Total
Construction* (Construction, S&A, PED/EDC, Contingency)	\$61,173	\$32,939	\$94,112
Construction LERRDs* (Lands and credits, easements, rights-of-way, relocations and disposal sites)	\$0	\$55,900	\$55,900
Monitoring and Adaptive Management	\$2,447	\$1,318	\$3,764
Total First Cost	\$63,620	\$90,157	\$153,777
Cost Share Adjustment**	\$36,355	(\$36,355)	
Total Cost-Shared Costs	\$99,955	\$53,822	\$153,777
Recreation Costs	\$5,587	\$5,587	\$11,173
Total First Costs	\$105,542	\$59,409	\$164,950

* Does not include IDC or annual O&M, the latter of which is fully a non-Federal Cost

**Non-Federal cost shared amount exceeds the 35% requirement for ecosystem restoration projects. Adjustment to the first cost amounts result to the 65-35 percent cost sharing requirement.

D. Project Implementation. The non-Federal sponsor for project implementation is the City of Phoenix, Arizona. The Monitoring and Adaptive Management Plan covers monitoring and adaptive management actions during the first 5 years after initial construction. After the first 5 years, monitoring and adaptive management will become the responsibility of the non-Federal Sponsor.

E. Operation, Maintenance, Repair, Rehabilitation, and Replacement (OMRR&R). In compliance with authorizing legislation and cost-sharing requirements, the non-Federal sponsor must assume responsibility for operation and maintenance of project features for as long as the project remains authorized. Operation and maintenance costs will include periodic channel clearance, control of invasive plant species, pumps and irrigation maintenance, and periodic replanting of habitat areas damaged by flood events. The expected average annual cost of OMRR&R is \$2,080,000.

F. Key Social and Environmental Factors. The alternatives are forecast to have positive long term impacts when compared to the no action alternative. They could have short term negative impacts due to construction activities; however, these could be mitigated through implementation of Best Management Practices. The proposed ecosystem restoration within Rio Salado Oeste would restore important riparian habitat through this reach of the Salt River. The restoration would be accomplished while causing no increase in predicted flood surface elevations. The detrimental effects of implementing the recommended plan would be primarily construction related as a consequence of very minor increase in traffic to and from the site, fugitive dust

emissions, and construction related noise. The positive cumulative effects of the Rio Salado Oeste ecosystem restoration include benefits from other ecosystem restoration feasibility studies and/or construction projects the Corps of Engineers is performing in the central Phoenix area of Maricopa County.

G. Stakeholder Perspective and Differences. The non-Federal views and preferences regarding environmental restoration were obtained through coordination with the non-Federal sponsor, various local and regional agencies and organizations, neighborhood associations, and the general public. These coordination efforts consisted of a series of public meetings held during the reconnaissance and feasibility study phases, through the maintenance of a 'point-of-contact' with whom any interest could discuss matters, and a mailing list by which invitations to public meetings were distributed. Announcements for public meetings were made in local newspapers, including date, time, place, and subject matter.

Formal and informal coordination occurred with a variety of Federal, State, and local agencies in addition to the public involvement efforts described above. Agencies contacted included the United States Fish and Wildlife Service (USFWS), the Arizona Department of Game and Fish (AGFD), the City of Phoenix Parks and Recreation, Phoenix Water Department, Flood Control District of Maricopa County (FCDMC), Maricopa County Parks and Recreation, and the Arizona Department of Transportation.

Representatives from USFWS and AGFD participated in development of the functional assessment model and its application for plan formulation. The USFWS, AGFD and FCDMC also participated in development of alternatives and their design. USFWS has provided a Fish and Wildlife Coordination Act Report for this study.

In general, comments received on the draft report were supportive. No major issues were identified as part of the public comment period. Plan features are consistent with the desires expressed by public. Implementation of the Recommended Plan is supported by the non-Federal Sponsor, agencies, and the public.

5.0 STATE AND AGENCY REVIEW

The final report and proposed Chief of Engineers' report were circulated to the State of Arizona and Federal agencies for comment on 27 October 2006 and published in the Federal Register on that date, with the 30-day review period ending on 27 November 2006. The State of Arizona, the Environmental Protection Agency, and the Departments of Interior and Agriculture all responded with no comment on this final report.



Fig. 1.0 General Study Area Location

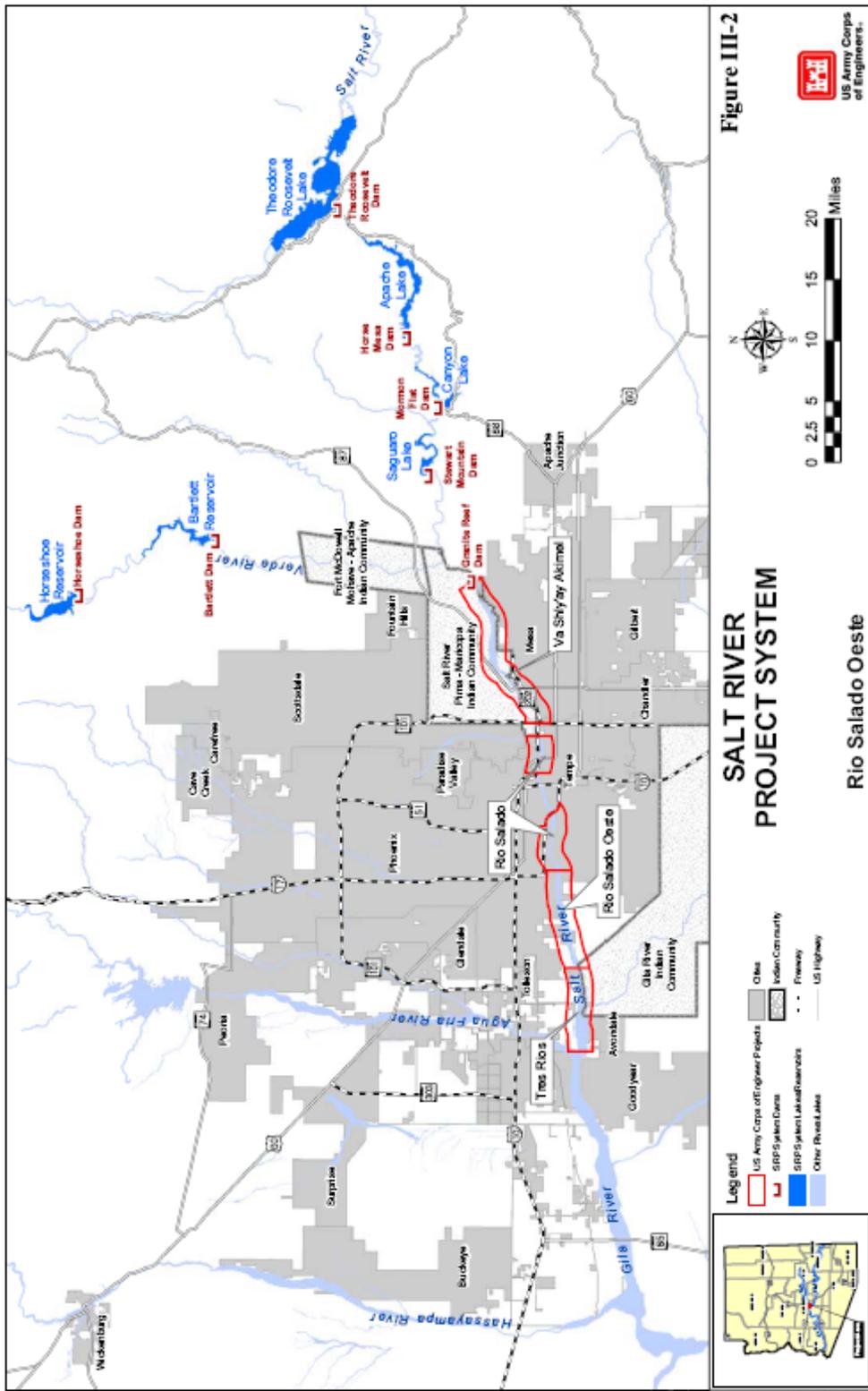


Fig 2.0 Salt River System in Metro Phoenix